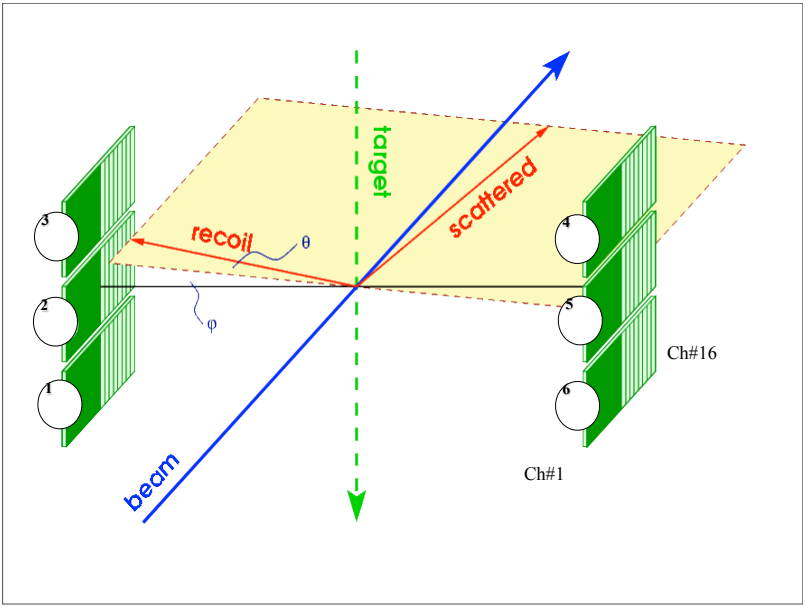
Outline

- Detector Overview
- Analysis Procedure
- Results
- Oustanding Issues

DETECTOR GEOMETRY



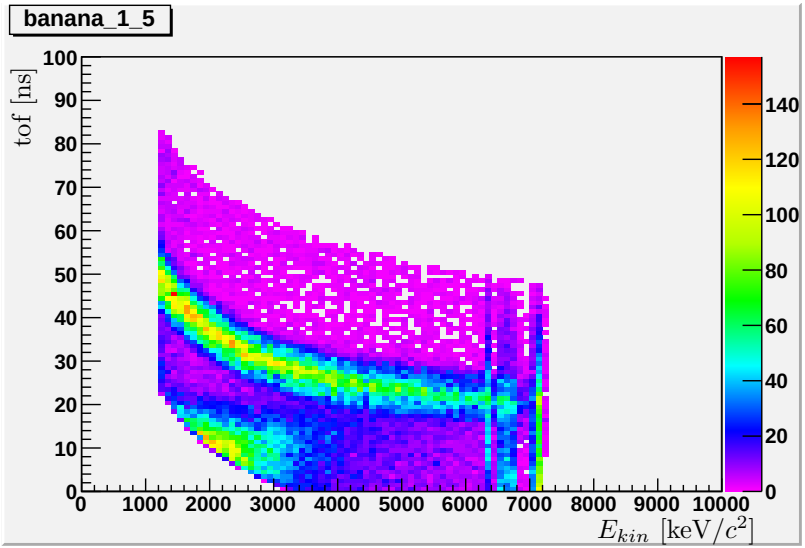
Elastic proton identification

The main problem is to identify a clean sample of elastically scattered protons

Start with energy-time of flight correlation

$$t \;=\; L \cdot \sqrt{\frac{m_p}{2 \cdot T_R}}$$

Elastic proton identification



ANGLE-ENERGY CORRELATION

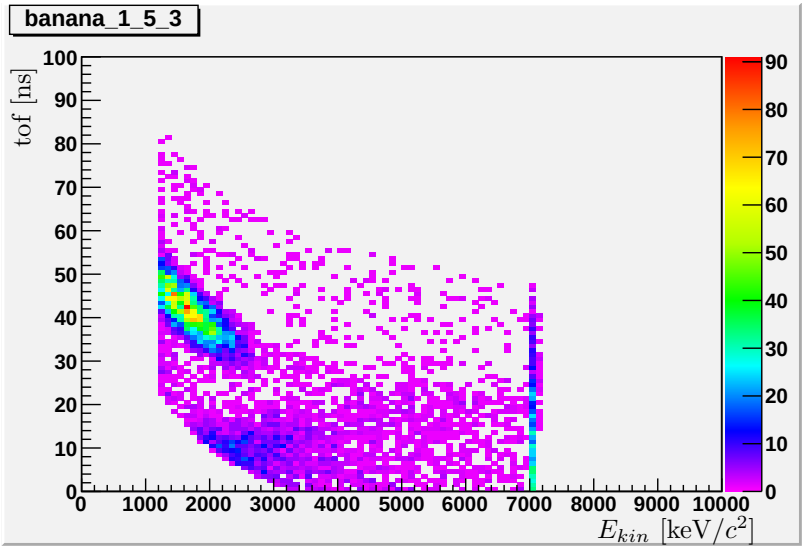
There is a correlation between scattering angle and kinetic energy of scattered proton:

$$M_x^2 = m_p^2 + t - 2E_1T_R + 2p_1p_R\sin\theta_R$$

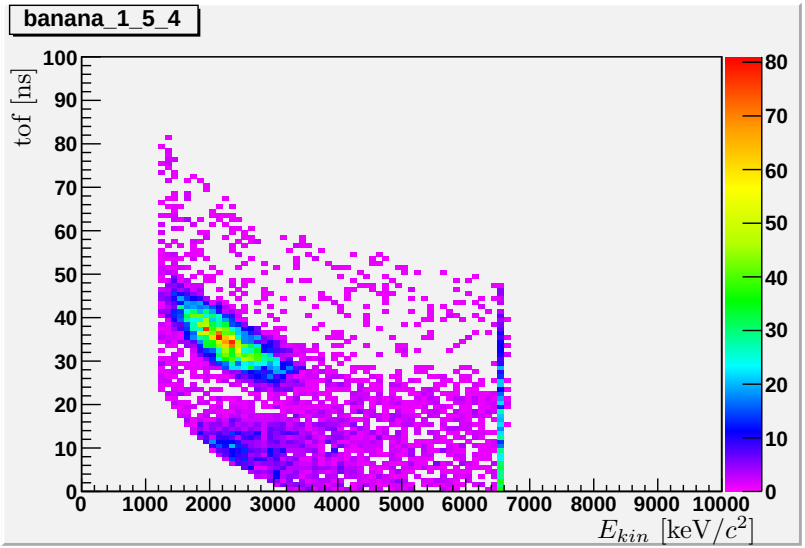
for small angles:

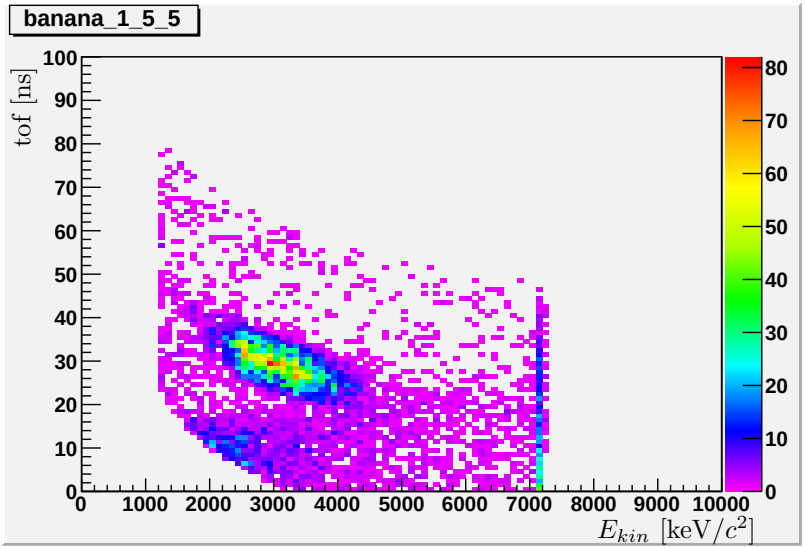
$$T_R \approx 2m_p\theta_R^2$$

STRIP-ENERGY CORRELATION

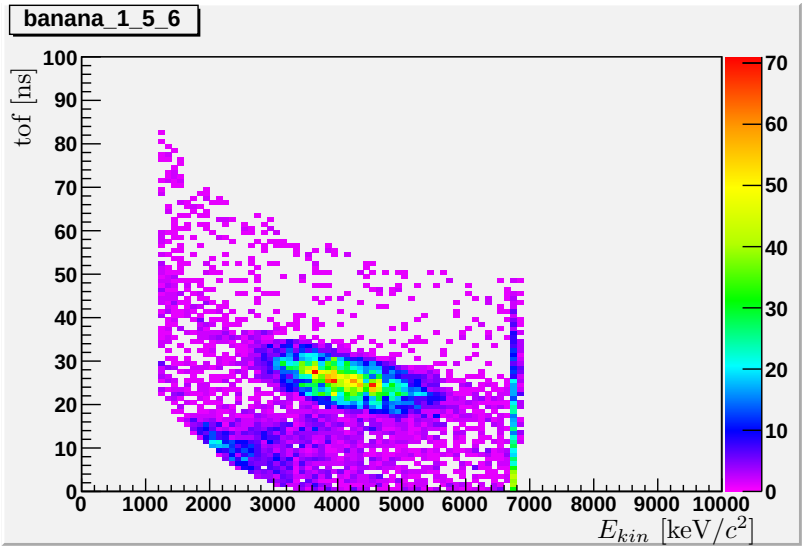


STRIP-ENERGY CORRELATION

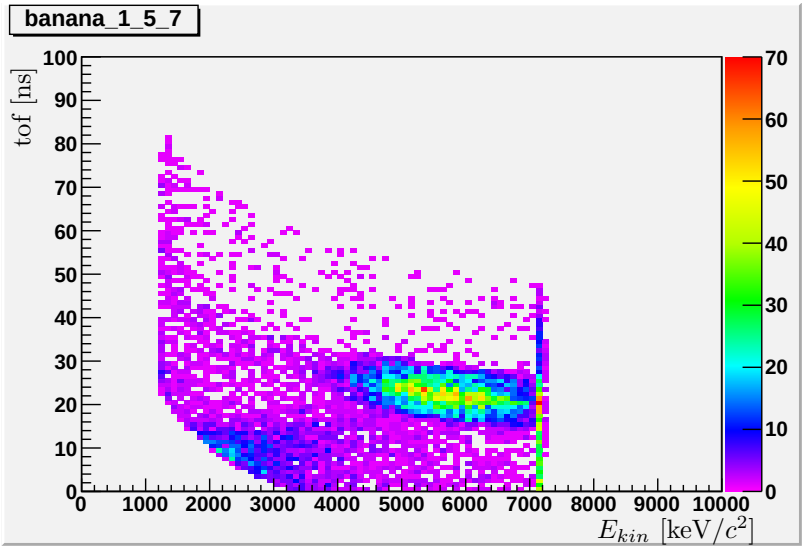


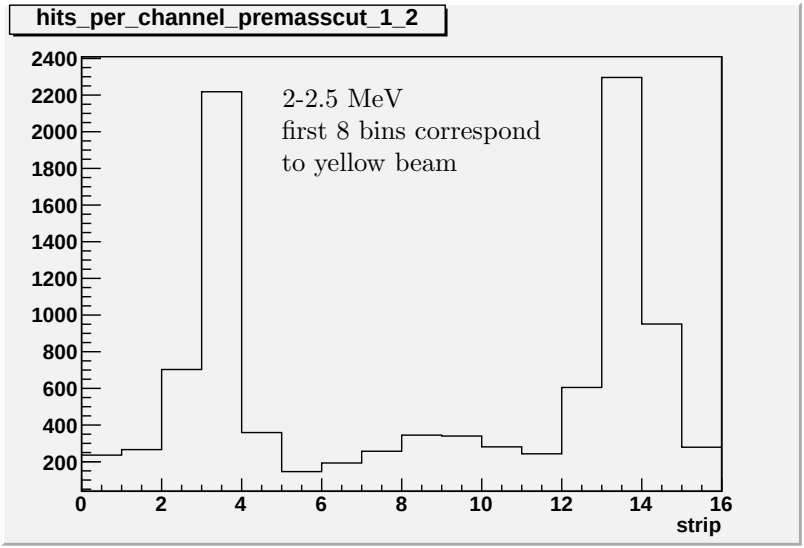

banana_1_5_5
tof [ns]
100
90
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
E_{kin} [keV/c^2]
80
70
60
50
40
30
20
10
0

STRIP-ENERGY CORRELATION

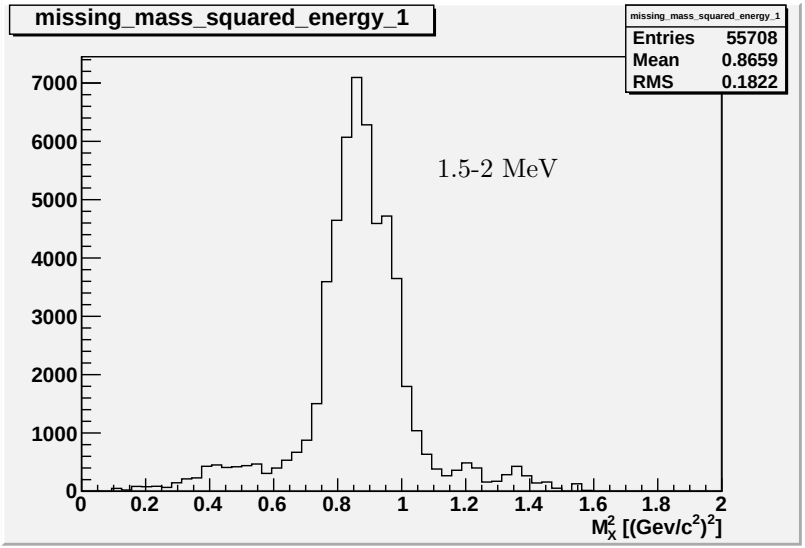


STRIP-ENERGY CORRELATION



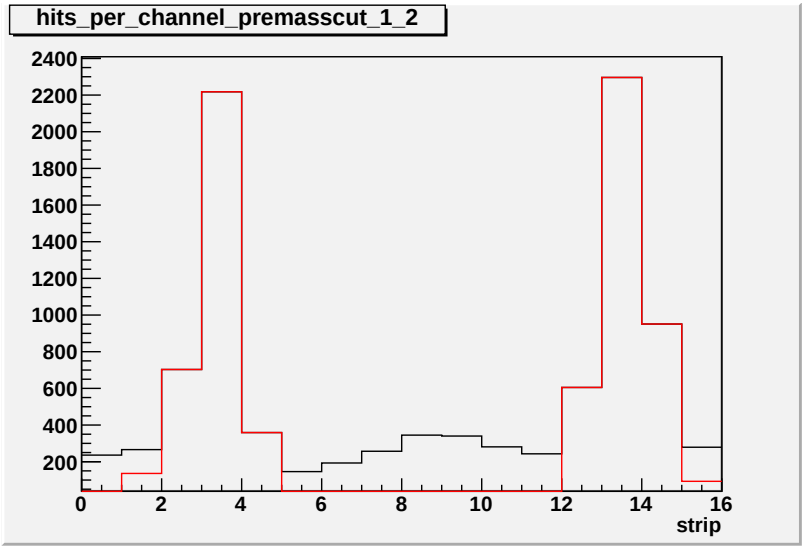


in a given energy bin, only a few strips will contain elastic signal. All strips contain background from hjet tail scattering?



mass cut on
$2(m^2 - 2E_{kin}(m + E_{beam}) + 2p_{beam}\sqrt{2mE_{kin}}\theta)$

BACKGROUND ESTIMATION

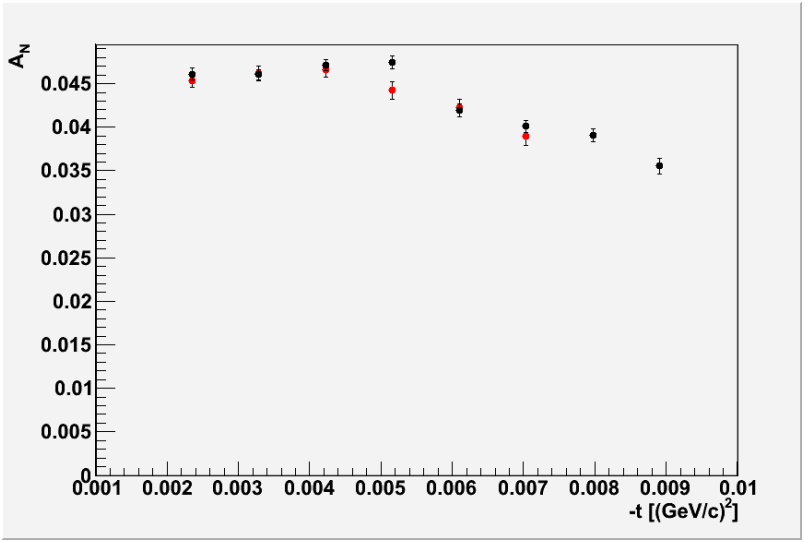


$$A_N = \frac{1}{P_t}\frac{\sigma^R_{0d} - \sigma^L_{0d}}{\sigma^R_{0d} + \sigma^L_{0d}} = \frac{1}{P_t}\frac{\sigma^R_{0u} - \sigma^L_{0u}}{\sigma^R_{0u} + \sigma^L_{0u}} = \epsilon_N / P_t$$

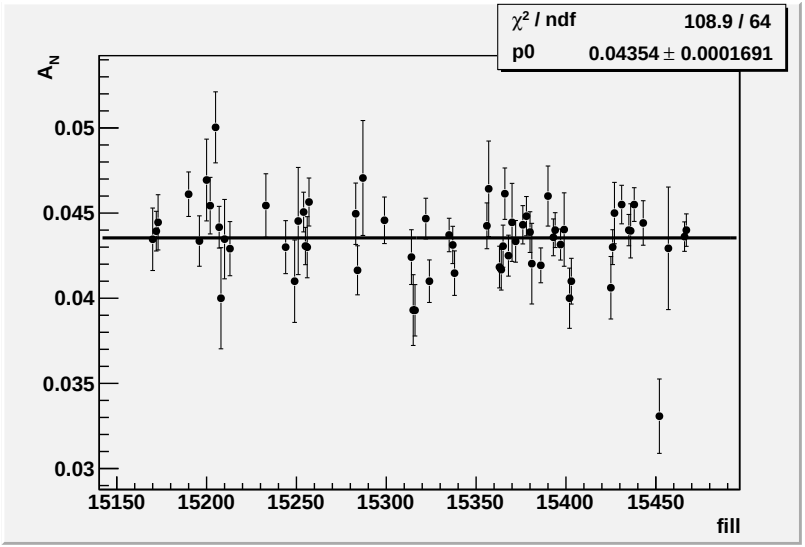
alternatively,

$$\epsilon_N = \frac{\sqrt{N^L_{0u} N^R_{0d}} - \sqrt{N^L_{0d} N^R_{0u}}}{\sqrt{N^L_{0u} N^R_{0d}} + \sqrt{N^L_{0d} N^R_{0u}}}$$

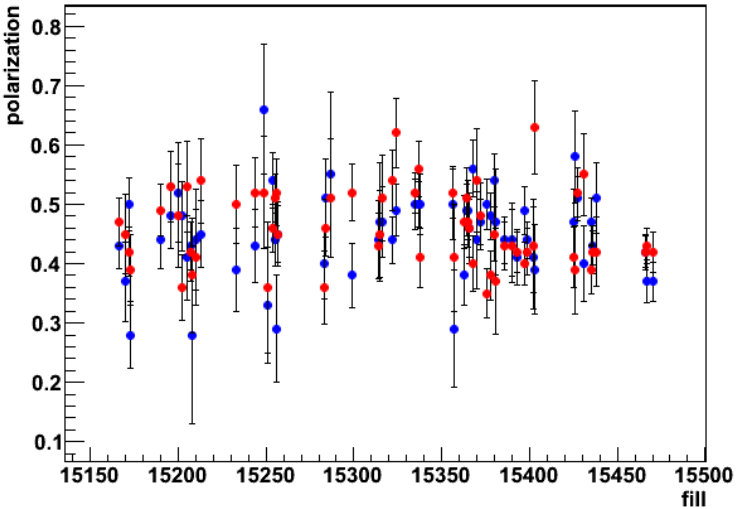
Then we scale up the A_N according to the estimated unpolarized background



250 GeV, red = run9, black = run11


χ^2 / ndf 108.9 / 64
p0 0.04354 ± 0.0001691
A_N
0.05
0.045
0.04
0.035
0.03
15150
15200
15250
15300
15350
15400
15450
fill

$$P_b = \frac{\epsilon_b}{\epsilon_N} P_t$$

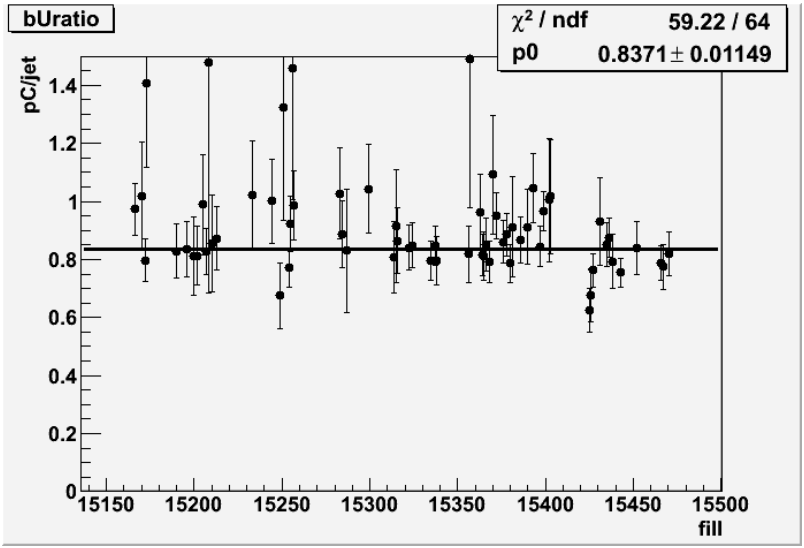


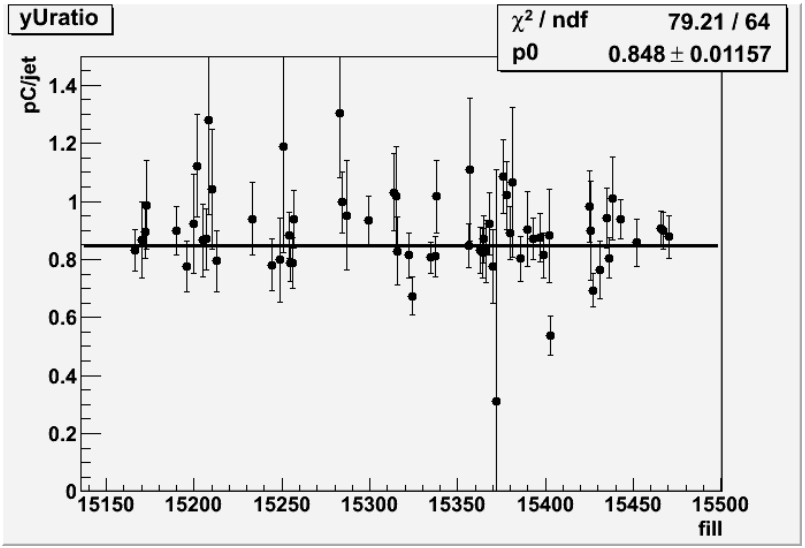
Ratio to pC

The following plots show the ratio of the polarization measured by the pC polarimeter to that measured by the jet polarimeter. The pC results for each detector are scaled by an overall normalization factor to match the jet results.

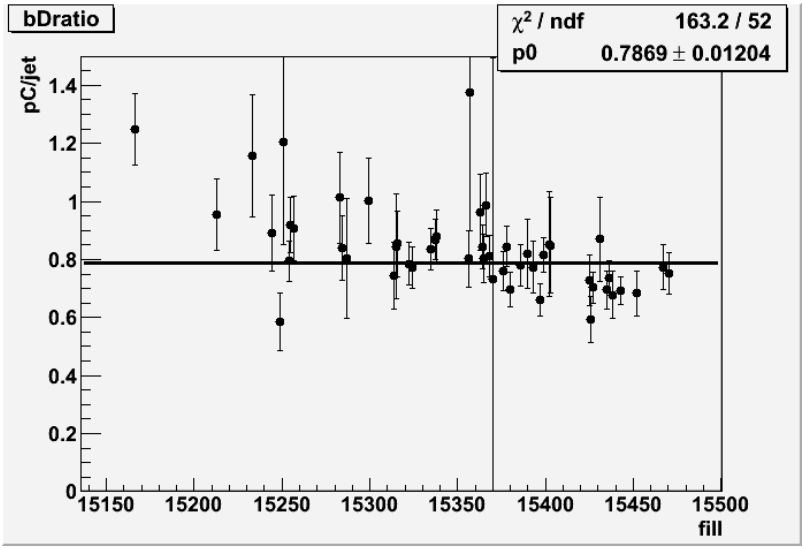
It should be noted that the pC results are already scaled by a somewhat arbitrary normalization, so the value of the ratio is not so important. What is important to note is the stability of the ratio through the run.

RATIO TO PC

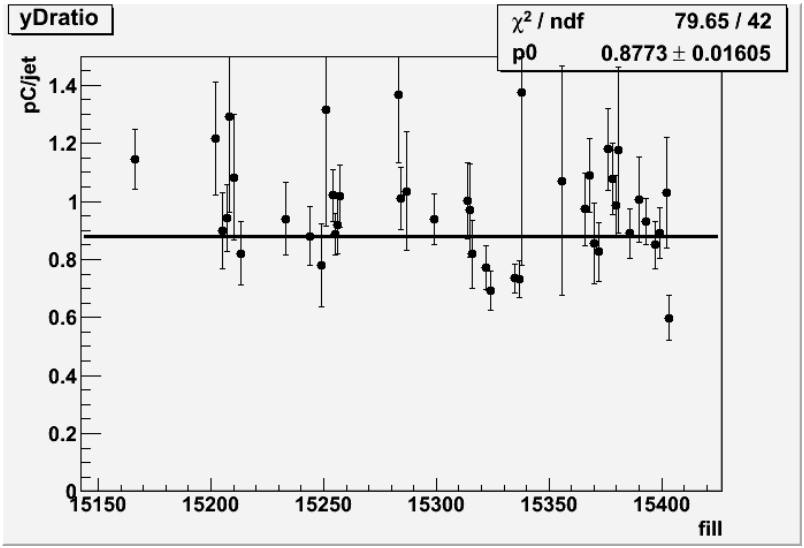

bUratio
χ² / ndf 59.22 / 64
p0 0.8371 ± 0.01149
pC/jet
1.4
1.2
1
0.8
0.6
0.4
0.2
0
15150
15200
15250
15300
15350
15400
15450
15500
fill


yUratio
χ² / ndf 79.21 / 64
p0 0.848 ± 0.01157
pC/jet
1.4
1.2
1
0.8
0.6
0.4
0.2
0
15150
15200
15250
15300
15350
15400
15450
15500
fill

RATIO TO PC


bDratio
χ² / ndf 163.2 / 52
p0 0.7869 ± 0.01204
pC/jet
1.4
1.2
1
0.8
0.6
0.4
0.2
0
15150
15200
15250
15300
15350
15400
15450
15500
fill

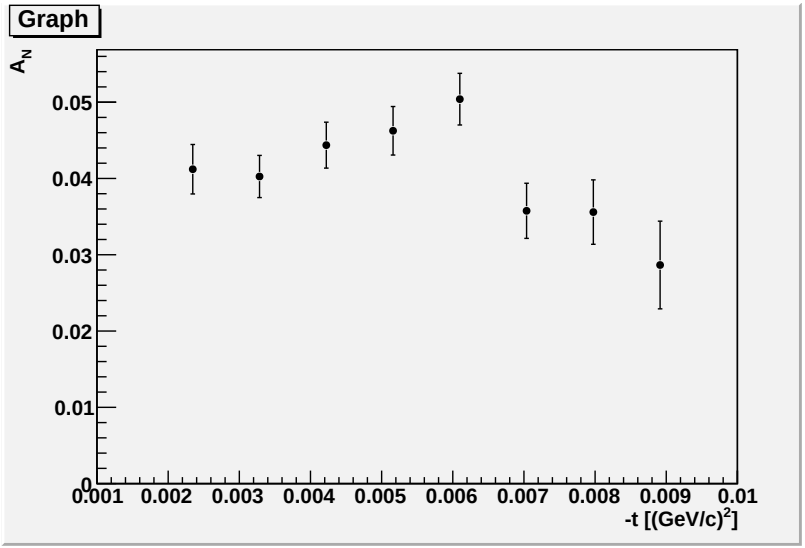
RATIO TO PC

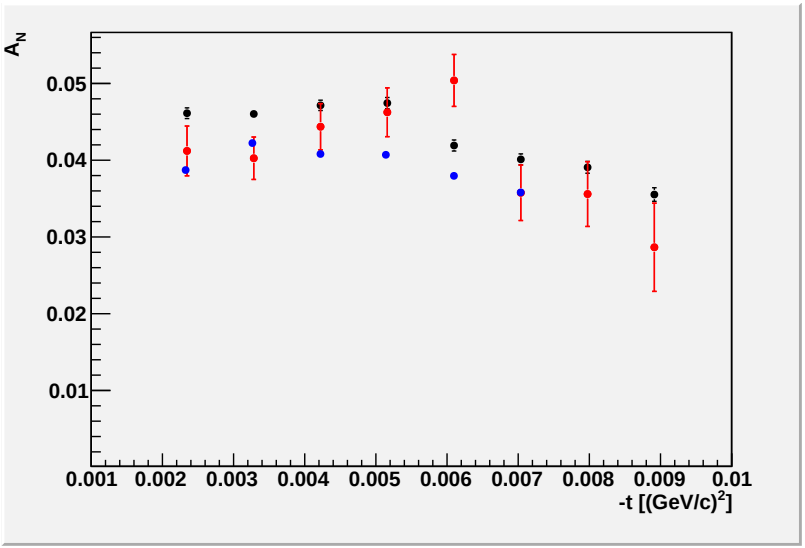

yDratio
χ² / ndf 79.65 / 42
p0 0.8773 ± 0.01605
pC/jet
1.4
1.2
1
0.8
0.6
0.4
0.2
0
15150
15200
15250
15300
15350
15400
fill

INJECTION ENERGY (PRELIMINARY)

Near the end of the run, we took data at injection energy with the jet. One fill had both beams and one fill had only the blue beam injected.

INJECTION ENERGY (PRELIMINARY)





black: 250 GeV, blue: 100 GeV, red: 24 GeV

INJECTION ENERGY (PRELIMINARY)

Blue Polarization:
$61\% \pm 4.3\%$

Yellow Polarization:
$65\% \pm 4.8\%$

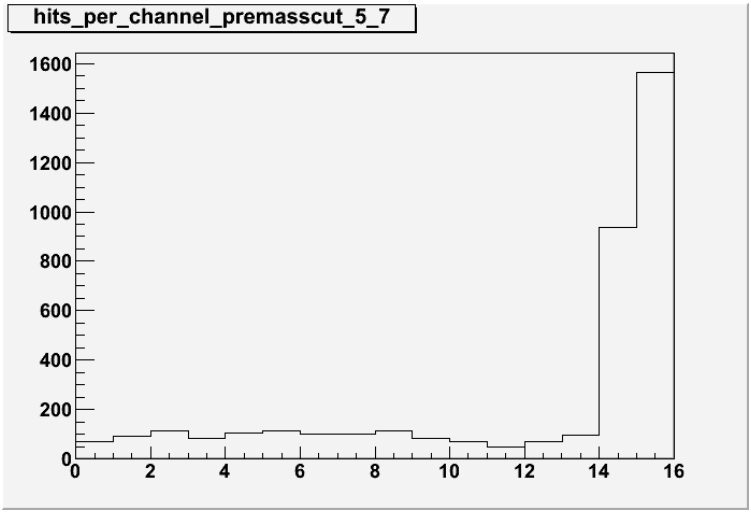
BLUE-ONLY INJECTION RUNS

For the data with only one beam, there is an asymmetry in the background. When both beams are present such asymmetry cancels since the asymmetry from the different beams have different signs.

It is important to note that in previous runs, the detector was not set up in such a way that this effect is noticable.

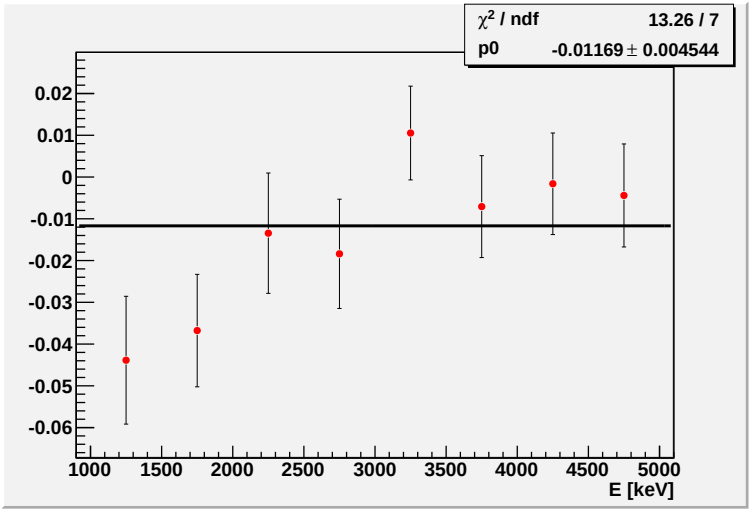
Nevertheless, even after this background asymmetry is corrected for, the blue beam polarization in this fill is only $47\% \pm 4.3\%$. The injection fill with both beams has higher polarization, and the pC polarimeter measures higher polarization for the blue-only fill as well. This mystery will be investigated by looking at data throughout the run during the abort gap of the other beam.

The following slides contain the asymmetry of the background and an example of the background level.

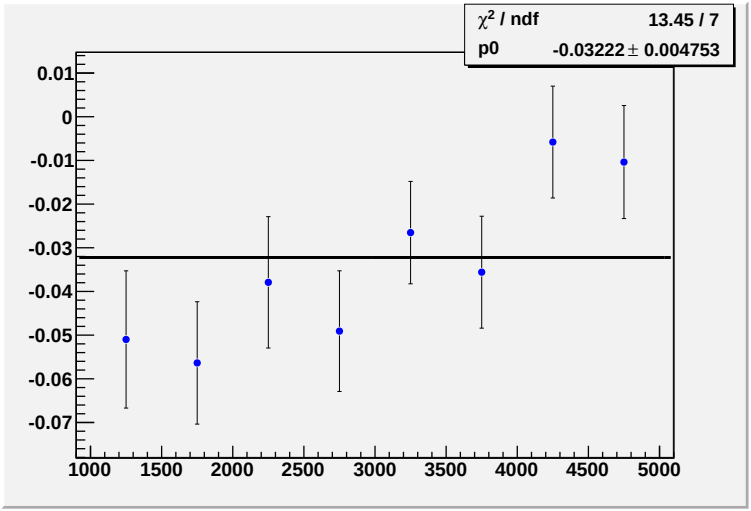


detector 5, 4.5-5.0 MeV. As much background in yellow and blue strips

BEAM ASYMMETRY



TARGET ASYMMETRY



Outstanding Issues

In the blue-only injection runs, the "background" has an asymmetry. It seems that the background has zero asymmetry because the asymmetry from blue and yellow have differents signs.

It is unclear why the jet measures low polarization in the blue-only injection energy fill. This will be investigated with 250 GeV abort gap data.

There is a bit more quality assurance to be done to get rid of bad periods, but the results from any fill will only barely change.